The Arctic: Hydrocarbon resources

THE WORLD ECONOMY CONTINUES TO EXPAND AT A rapid pace, led by emerging economies such as China, Brazil and India. Demand for energy and other resources is increasing in tandem, which helps explain the rapid rise in the price of many key commodities that we witnessed during the recent years of sustained economic expansion. Reserves of some important resources, particularly oil, are also becoming more difficult to replace. The result is that energy and mining companies are scouring the globe for new sources of supply in frontier regions – such as the Arctic – that until recently had attracted minimal interest.

Adding to this growing interest in the Arctic is the prospect that the shrinking polar ice cover will soon make resources more accessible. Shipping lanes are opening up, thereby reducing the costs and risks of access. This is advantageous not only for those engaged in oil and gas exploration and production, but also for mining companies seeking to develop the diamond, gold, silver, zinc, iron and other mineral resources found in the Arctic.

This paper provides a broad overview of the hydrocarbon resource base in the Arctic. It describes existing projects and those under development, highlights obstacles to development, and comments on the outlook for resource development in the Canadian Arctic specifically and the Arctic region more generally.

Hydrocarbon resources in the Arctic

Overview. Mineral resources, and hydrocarbons in particular, are abundant throughout the Arctic. The region contains proven reserves of oil and gas, diamonds, gold, tin and platinum, to name a few key commodities. Of these, given their size and value, oil and gas reserves, along with diamond deposits, are garnering the most sustained interest in Canada.

The Arctic is the source of about 10% of the world's oil production and 25% of its gas production. Russia is the principal producer of hydrocarbons in the Arctic (80% of the oil and 99% of the gas).

Although relatively little exploration has been carried out to date in the Arctic, and despite the fact that estimates vary, there is widespread agreement that considerable resources remain to be exploited. According to a 2008 US Geological Survey assessment, "The Arctic accounts for about 13 percent of the undiscovered oil (90 billion barrels of undiscovered, technically recoverable oil), 30 percent of the undiscovered natural gas (1,670 trillion cubic feet [Tcf] [47.3 trillion cubic metres] of technically recoverable natural gas), and 20 percent of the undiscovered natural gas liquids (44 billion barrels of technically recoverable natural gas liquids) in the world." These resources north of the Arctic Circle "account for about 22 percent of the undiscovered, technically recoverable resources in the world."[1]

These estimates may be conservative, given the vast areas of the Arctic that remain largely unexplored. Moreover, resource estimates may change substantially with improvements to technology and geoscientific information. According to the mainstream view, the already substantial production of oil and gas in the Arctic is likely to increase in the coming decades in response to growth in global energy demand. Large discoveries are considered likely, and drilling is proceeding in certain areas of interest, notably in the Beaufort Basin and on the Russian continental shelf.

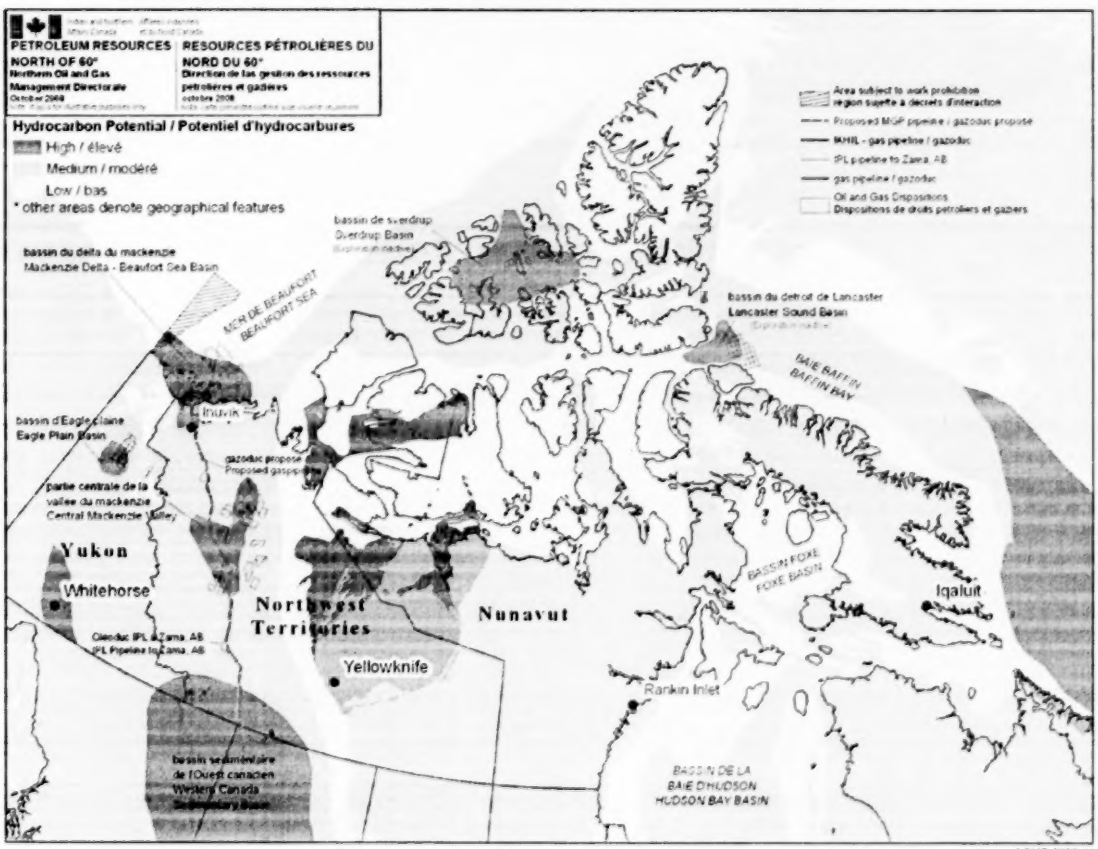
Hydrocarbon resources in the Canadian Arctic. The land area in Canada's North (north of 60 degrees latitude) has been known to be rich in hydrocarbon resources since the discovery of oil at Norman Wells, Northwest Territories, in 1920. Production of oil at Norman Wells continues even now at a rate of about 20,000 barrels per day.

In the 1970s and early 1980s, the Canadian government invested in Arctic oil and gas exploration. Important discoveries were made in the Mackenzie Delta–Beaufort Sea Basin and in the Arctic islands.[2] Interest in the Arctic diminished once the effects of the oil shocks of the 1970s subsided, and the federal government withdrew its support for exploration.

Although current production is small, Canada's Arctic region holds abundant oil and gas development opportunities. According to Indian and Northern Affairs Canada (INAC), 1.7 billion barrels of oil and 31 Tcf (880 billion cubic metres) of gas have already been discovered in Canada's North, of total potential resources (discovered plus undiscovered) of some 8.4 billion barrels of oil and 153 Tcf (4.3 trillion cubic metres) of natural gas.[3] These potential resources represent about 25% and 33%, respectively, of Canada's remaining resources of conventional crude oil and natural gas.

According to INAC, the development of multiple major fields in the North is possible, specifically in the Mackenzie Delta–Beaufort Sea Basin and in the Arctic Archipelago and intervening channels[4] (e.g., Sverdup Basin, Lancaster Sound Basin; see Figure 1). The Sverdrup Basin alone is thought to contain over 17 Tcf (481 billion cubic metres) of recoverable gas, which is equivalent to nearly three years' worth of total Canadian gas production. The resource base in the western Beaufort Sea is also thought to be substantial, but there has been very little exploration there to date in view of the ongoing dispute between Canada and the United States over the maritime international boundary between Alaska and Yukon. The Amauligak oil field in that area has been described as the most significant Canadian Arctic discovery to date. According to INAC, new giant discoveries in Canada's North are also a possibility.

Figure 1: Petroleum resources north of 60 degrees latitude in Canada



Source: Indian and Northern Affairs Canada.

In recent years, record oil prices and near-record gas prices have spurred private and public interests to take steps to access these resources. In July 2007, Imperial Oil and ExxonMobil Canada won a $585-million bid to explore a 205,000-hectare parcel in the Beaufort Sea for oil and gas. More recently, in June 2008, six companies won bids to explore for oil and gas in the Beaufort Sea and Mackenzie Delta. BP Exploration alone has committed $1.18 billion for exploration of a 202,380-hectare parcel in the Beaufort Sea. In 2008, the Government of Canada announced that it would invest $100 million over the next five years in geo-mapping for energy and minerals, mainly to locate resources in Canada's North.

The success of the Mackenzie Gas Project, which includes the Mackenzie gas pipeline project to bring Arctic gas from the Mackenzie Delta to markets in Alberta and beyond, is critical for the development of hydrocarbon resources, particularly gas, in the Canadian Arctic. Without a pipeline to transport gas south, gas from the Mackenzie Delta and beyond is likely to remain stranded in the near term.

The $16.2-billion Mackenzie Gas Project, led by Imperial Oil and its partners, including the Aboriginal Pipeline Group, still faces a number of challenges. Notably, the regulatory process has been slow and cumbersome, and the project is not likely to receive approval from the many regulatory authorities concerned until 2009 at the earliest. Aboriginal land claims and land access issues have likewise yet to be fully resolved. Finally, proponents of the project have for several years now raised questions about the economics of the project and have sought the development of a supportive "fiscal framework" for what is by far the largest industrial project ever undertaken in the Canadian North. Many in Canada's energy industry consider the Mackenzie Gas Project a litmus test for Canadian frontier energy development in general.

Role of the federal government. Indian and Northern Affairs Canada is responsible for the management of hydrocarbon resources on Crown lands in the Northwest Territories, Nunavut and the Northern offshore. Legislative authority is provided under the *Canada Petroleum Resources Act* and the *Canada Oil and Gas Operations Act*. INAC is responsible mainly for the issuance, registration and administration of petroleum rights and for the administration of the royalty regime in the North.[3] In 2007, INAC collected $25 million in royalties from five producing fields in the North. The federal government also has a one-third interest in the Norman Wells operation, which contributes over $100 million per year to the federal treasury. For its part, Natural Resources Canada has undertaken numerous geoscientific studies in support of resource development in the North.

Hydrocarbons in other Arctic regions. The American and Russian Arctic regions are particularly rich in hydrocarbon resources. The North Slope region of Alaska accounts for about 20% of current US oil production. The oil is piped from Prudhoe Bay in northern Alaska to Valdez, Alaska, where it is shipped by tanker primarily to markets in the lower 48 states. The Alaskan Arctic coast is thought to hold at least 27 billion barrels of oil, an amount roughly equivalent to four years' worth of US oil consumption. Alaska also holds at least 35 Tcf (1 trillion cubic metres) of natural gas that remain untapped: cost pressures and regulatory and political holdups have delayed by decades the development of an Alaskan gas pipeline. Trans-Canada Pipelines is considered a front-runner to develop the Alaska Highway Pipeline Project, which would transport natural gas from Prudhoe Bay to southern markets. Because regulatory reviews and environmental assessments have not yet begun for the Alaska Highway Pipeline Project, it lags behind Canada's Mackenzie Gas Project by a number of years. Although some analysts take the view that the two projects are not mutually exclusive by virtue of the insatiable North American demand for natural gas, others argue that labour, steel and equipment shortages would prevent the two pipelines from being built concurrently.

As with the US, an important proportion of Russia's oil and gas production occurs in that country's Arctic region. In fact, Russia is the dominant Arctic producer of oil and gas, and holds over 75% of

known Arctic oil, over 90% of known Arctic gas, and vast estimated undiscovered oil and gas resources.[6] The Western Siberia Basin alone accounts for about half of Russia's oil production. Gazprom, the Russian state-controlled energy company, is developing gas fields in the Barents Sea (the Shtokman field) that are said to contain twice as much gas as all of Canada's gas reserves. The relatively undeveloped Chukchi Sea, lying between northwestern Alaska and eastern Siberia, also contains important reserves of oil and gas.

Norway and Denmark (Greenland) also have significant assets in the Arctic. For example, Norway's Statoil is actively developing gas fields in the Barents Sea, and exploration is ongoing off the shores of Greenland and off the Faroe Islands in the Norwegian Sea.[7]

Resources in the High Arctic. Concurrent with the rising interest in the High Arctic region and the potential rewards of its natural resources, the circumpolar states of Canada, Denmark, Russia and Norway are mapping their continental shelves in the Arctic and delineating their resource access in a process set out in the United Nations Convention on the Law of the Sea (UNCLOS).[8] Although no firm delineation of the High Arctic is expected until well into the next decade, the stakes and activity in this regard are peaking.[9] Notably, the Russians have gone to great lengths to assert that the Lomonosov Ridge is an extension of the Siberian Continental Platform and, therefore, that the mineral deposits found there belong to Russia. Russian scientists estimate that this area accounts for about two thirds of the Arctic's total hydrocarbon resources. Canada, meanwhile, has also undertaken seabed mapping activities and other scientific studies to support a counterclaim to this disputed Arctic ridge and its resources.

Gas hydrates. Although oil and natural gas are abundant in the Arctic, the region harbours vastly larger quantities of natural gas in the form of gas hydrates that one day could become economically viable to produce. Gas hydrates are ice-like substances composed of water and natural gas that form when gases combine with water at low temperatures and under high pressure. According to Natural Resources Canada, gas hydrates represent a vast global reservoir of natural gas, as they are estimated to contain more organic carbon (as methane) than all other known fossil fuel sources combined. Gas hydrates are widespread in permafrost regions and on deep sea continental slopes. The Mackenzie Delta contains some of the world's most concentrated deposits of gas hydrates. The Canadian government has been involved in international gas hydrates research since 1985. Research on gas hydrates, including investigation of extraction and production methods, is ongoing. Energy experts are divided as to the long-term technical and economic viability of producing gas from gas hydrates.

Challenges to development

The development of energy projects in the Arctic is impeded by a number of practical considerations, as outlined below.

Climate. The Arctic climate and weather conditions – including ice cover on land and sea, extreme cold, and high winds – translate into a challenging physical environment for exploration and development. Working conditions are difficult, access to resources is sometimes restricted by weather, operating seasons are shorter, special equipment is often required, and costs are correspondingly higher. For example, rigs capable of drilling in the harsh northern environment are relatively scarce and are considerably more expensive to contract and operate than rigs designed for southern regions.

Infrastructure and regulations. The lack of infrastructure in the Arctic (roads, ports, pipelines, tanker facilities, etc.), itself a function of the climate, is widely cited along with social and ecological risks as a major impediment to development. The complex regulatory environment in Canada's Arctic region which, as the Mackenzie Gas Project demonstrates, contributes to long approval times and uncertainty for project proponents, is also frequently cited as a major obstacle.

Economics. The economics of Arctic oil and gas development are defined principally by practical infrastructure factors as well as by distance to markets. Oil basins with good access to markets via

pipelines and ice-free seas are relatively attractive investment projects (e.g., in Alaska's North Slope). Gas, however, is more costly to transport than oil and, in North America at least, the infrastructure to transport Arctic gas to markets in the south has yet to be constructed. The development of Canada's Arctic gas reserves depends significantly on the construction of the Mackenzie Valley pipeline. Once the pipeline is built, the economics of developing additional gas fields in the Mackenzie Delta and beyond will improve substantially. An alternative would be to transport the gas by tanker in a liquefied state to regasification terminals on the eastern seaboard, assuming that acceptable transportation routes can be found.

Emphasizing the impact of such obstacles, a November 2006 report by the energy consultancy Wood Mackenzie and Fugro Robertson "calls into question the long-considered view that the Arctic represents one of the last great oil and gas frontiers and a strategic energy supply cache for the US ... The oil–gas mix is not ideal because remote gas is often much harder to transport to markets ... Export and technology constraints are expected to delay production."[10]

Environment. Energy projects in the Arctic will bring economic benefits but will also affect sensitive ecosystems and the traditional lifestyles of northern peoples. The Arctic is an extremely sensitive marine environment on which many people, the Inuit in particular, depend for their livelihood. An oil spill would significantly damage the Arctic ecosystem,[11] which is why Canada's Parliament adopted the *Arctic Waters Pollution Prevention Act* nearly 40 years ago, "to see that the natural resources of the Canadian arctic are developed and exploited and the arctic waters adjacent to the mainland and islands of the Canadian arctic are navigated only in a manner that takes cognizance of Canada's responsibility for the welfare of the Inuit and other inhabitants of the Canadian arctic and the preservation of the peculiar ecological balance that now exists in the water, ice and land areas of the Canadian arctic."[12] On land, Arctic landscapes are said to recover slowly from physical disturbances associated with oil and gas activity.

Measures to protect the fragile Arctic environment, including but not limited to moratoria on tanker traffic on key routes, could significantly dampen exploration and production activities or, at the very least, raise the cost of such activities. And while climate change is expected to facilitate access to Arctic resources by virtue of the shrinking sea-ice cover, on land the melting permafrost complicates the construction of roads, pipelines and other infrastructure associated with oil and gas projects. According to a recent study by the Arctic Council, it remains to be seen whether climate change will make the Arctic more, or less, attractive for oil and gas activities.[13]

Conclusion

Exploration and development activity in the Arctic region, including in Canada, is on the rise. But important obstacles to development remain. These include an almost complete lack of infrastructure, high operating costs, a hostile yet fragile natural environment, a complex regulatory regime, and distance to markets. Although development in the Mackenzie Delta–Beaufort Sea Basin will in time proceed should the Mackenzie Valley pipeline be built, development further afield (e.g., in the Arctic Archipelago) is viewed by the industry as highly unlikely within the next 15 years. These factors make it difficult to predict the pace and extent of development in the Canadian Arctic. In the near term it is probable that exploration and development activity will remain muted as long as other more easily accessible areas or resources, such as coal-bed methane in Alberta and British Columbia, and oil and gas off British Columbia's shores and on the outer continental shelf, remain to be developed to supply the rapidly increasing global demand for oil and gas.

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SOURCES

1. US Geological Survey, "90 Billion Barrels of Oil and 1,670 Trillion Cubic Feet of Natural Gas Assessed in the Arctic," News release, 23 July 2008, http://www.usgs.gov/newsroom/article.asp?ID=1980.
2. Petro-Canada is the principal leaseholder of all the Significant Discovery Licences (SDLs) in Canada's Arctic islands. SDLs grant the holder indefinite tenure over lands declared a discovery by the National Energy Board. The Government of Nunavut would like the Government of Canada to issue drill orders to the holders of SDLs in order to stimulate development.

3. Senate, Standing Committee on Energy, the Environment and Natural Resources, *Evidence*, 2nd Session, 39th Parliament, 11 March 2008, p. 5:6, (Mr. Patrick Borbey, Assistant Deputy Minister, Northern Affairs, Indian and Northern Affairs Canada), http://www.parl.gc.ca/39/2/parlbus/commbus/senate/Com-e/enrg-e/05evb-e.htm?language=E&Parl=39&Ses=2&comm_id=5.
4. Ibid.
5. In 2003, Ottawa devolved management responsibility over Crown lands and resources to the Yukon Government. Nunavut and the Northwest Territories are hoping to strike a similar arrangement with the federal government.
6. AMAP Working Group, *Arctic Oil and Gas 2007*, Arctic Monitoring and Assessment Programme, Oslo, Norway, 2007.
7. For a detailed map of resource development projects in the Arctic see UNEP, GRID-Arendal, "Industrial development in the Arctic," http://maps.grida.no/go/graphic/industrial-development-in-the-arctic.
8. The United States has not ratified UNCLOS and therefore has not participated in mapping exercises in this context.
9. François Côté and Robert Dufresne, *The Arctic: Canada's Legal Claims*, PRB 08-05E, Parliamentary Information and Research Service, Library of Parliament, Ottawa, 24 October 2008.
10. Sam Fletcher, "Special Report: WoodMac Arctic has less oil than earlier estimated," *Oil and Gas Journal*, Vol. 104, No. 42, 13 November 2006.
11. An oil spill would be particularly disastrous in the Arctic, notably because of the increased environmental persistence of petroleum hydrocarbons and the difficulty of clean-up in remote areas.
12. R.S.C. 1985, c. A-12.
13. AMAP Working Group (2007).

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